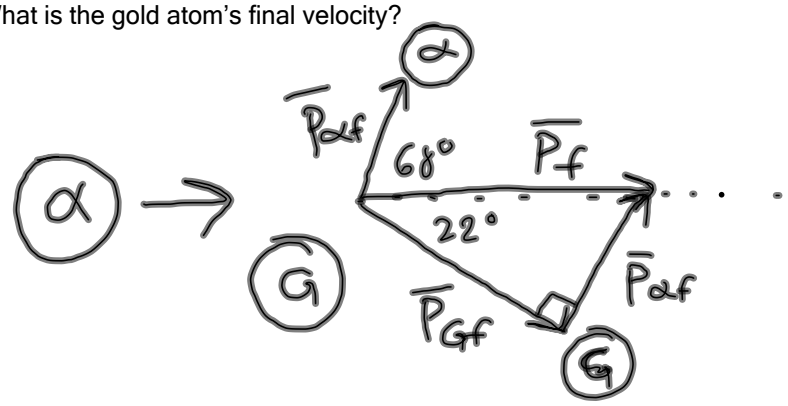
Test Review 2.14.12 Honors Physics

An alpha particle (mass = 6.64 E -27 kg) moving 1.50 E 7 m/s hits a gold atom (mass = 3.27 E -25 kg). After they hit, the gold atom is moving to the right at a 22 degree angle from the alpha particle's original direction. The alpha particle is now moving at a 68 degree angle to the left of its original direction.

a. What is the alpha particle's final velocity?

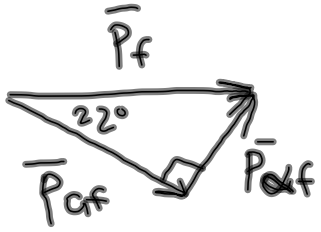
b.What is the gold atom's final velocity?



$$\bar{P}_f = \bar{P}_i$$

$$= \bar{P}_{\alpha i} + \bar{P}_{Gi}^{\,0}$$

$$= m_\alpha \bar{V}_{\alpha i} = 9.96E-20 \text{ kg·m/s}$$



$$P_{Gf} = P_f \cos(22°) = 9.23E-20 \text{ kg·m/s}$$

$$P_{\alpha f} = P_f \sin(22°) = 3.73E-20 \text{ kg·m/s}$$

$$V_{Gf} = \frac{P_{Gf}}{m_G} = 2.82E5 \text{ m/s} \qquad V_{\alpha f} = 5.7E6 \text{ m/s}$$

Conceptual Review:

- Ways to change impulse or momentum

1) change force

2) change time

3) change mass

4) change velocity

Which collision causes the highest force?

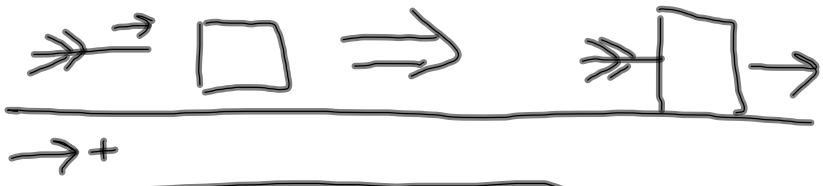
$$\bar{F} = \frac{m\Delta\bar{v}}{\Delta t} = \frac{m(\bar{v}_f - \bar{v}_i)}{\Delta t}$$

hit, neither bounces

hit, one bounces, other doesn't

hit, both bounce

A dart has an initial velocity of 90 m/s and it collides and sticks in a stationary block (mass = 10 kg). If they slide together at a velocity of 8 m/s, what is the mass of the dart?



1-D inelastic hit/stick

d = dart
b = block

$$m_d \bar{v}_{di} + m_b \bar{v}_{bi} = (m_d + m_b)\bar{v}_f$$

$$m_d v_{di} = m_d v_f + m_b v_f$$

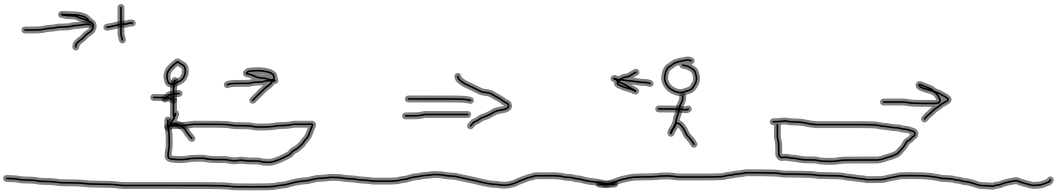
$$m_d v_f - m_d v_{di} = m_b v_f$$

$$m_d (v_f - v_{di}) = m_b v_f$$

$$m_d = \frac{m_b v_f}{(v_f - v_{di})}$$

$$= 0.976 \text{ kg}$$

A person (mass = 85 kg) is standing in a boat, and they are floating down a river at 2 m/s. (mass = 15 kg) If the person jumps "upstream" with a velocity of 6 m/s, what is the final velocity of the boat?



1-D inelastic "together/apart"

$$(m_p + m_b)\bar{v}_i = m_p\bar{v}_{pf} + m_b\bar{v}_{bf}$$

$$m_b\bar{v}_{bf} = (m_p + m_b)\bar{v}_i - m_p\bar{v}_{pf}$$

$$\bar{v}_{bf} = \frac{1}{m_b}\left[(m_p + m_b)\bar{v}_i - m_p v_{pf}\right]$$

$$= 47.3 \text{ m/s}$$

Problem Types:

- Impulse/Momentum

$$\bar{J} = \Delta\bar{p}$$

$$\bar{F}\Delta t = m\Delta\bar{v} = m(\bar{v}_f - \bar{v}_i)$$

- 1-D:
  - Elastic (hit/bounce)

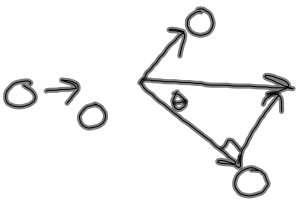
$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

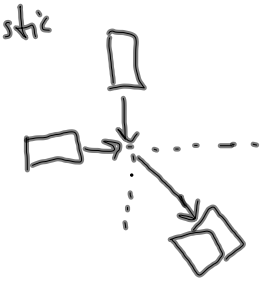
  - Inelastic
    - hit/stick

$$m_1\bar{v}_{1i} + m_2\bar{v}_{2i} = (m_1 + m_2)\bar{v}_f$$

    - together/apart

$$(m_1 + m_2)\bar{v}_i = m_1\bar{v}_{1f} + m_2\bar{v}_{2f}$$

- 2-D:
  - Elastic 

  - Inelastic 

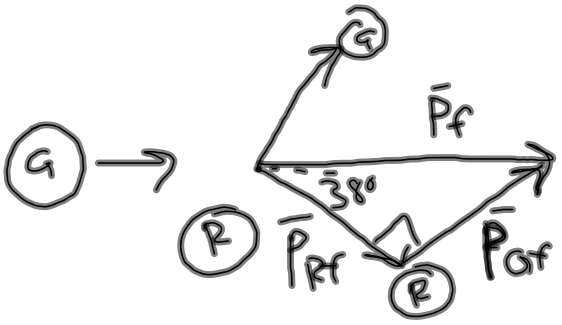
Green ball $m_G = 10\ kg$ $v_{Gi} = 10\ m/s$

Red ball stationary initially, $m_R = 6\ kg$

Green final angle = 52°

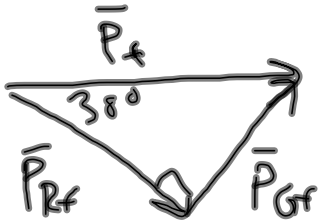
Red final angle = 38°

Find final green and red velocities.



$$\bar{P}_f = \bar{P}_{Gi} + \bar{P}_{Ri}$$

$$= 100\ kg \cdot m/s$$



$$P_{Rf} = P_f \cos(38°)$$

$$= 78.8\ kg \cdot m/s$$

$$P_{Gf} = P_f \sin(38°)$$

$$= 61.57\ kg \cdot m/s$$

$$V_{Rf} = \frac{P_{Rf}}{m_R} = 13.13\ m/s$$

$$V_{Gf} = \frac{P_{Gf}}{m_G} = 6.16\ m/s$$